# From Friend to Foe to Friend Again: Eliciting Personification of Pre-Service Teachers' Beliefs of Mathematics

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This paper reports about using eliciting personification (Zazkis, 2015) as a means to study pre-service teachers' (PSTs) beliefs. The method has the PSTs' create a character named Math and describe their relationship with the character. The authors analyzed 68 personifications from college sophomore PSTs' in an elementary math content course. At the end of the semester, the PSTs; revisited the assignment by describing a new character based on the math learned in class and writing a dialogue to themselves. At the beginning of the semester, the PSTs described math as having multiple personalities, out to hurt them, and having a relationship that fell apart throughout the years. The math described at the end was more compassionate, welcoming, and easier to understand.

Keywords: Teacher Beliefs, Narrative Identity, Pre-service Teachers

## Introduction

The recently released Association of Mathematics Teacher Educations Standards for Teacher Preparation states that "All teachers, including well-prepared beginners, must hold positive dispositions about mathematics and mathematics learning, such as the notions that mathematics can and must be understood, and that each and every student can develop mathematical proficiency" (AMTE, 2017, p 2.7). A goal for mathematics classes for PSTs should be to try and align the students' beliefs that align with those positive dispositions about mathematics and mathematics learning. Studies (e.g., Philippou & Christou, 1998) have shown that teachers tend to come into these courses with negative dispositions about mathematics.

In this study, we focus on the beliefs of prospective mathematics teachers enrolled in an elementary mathematics content course taught in a mathematics department. The aim of this study is to see if the method of eliciting personification provides insight into PSTs' beliefs that other metrics fail to capture. The results from the assignment were used in several ways throughout the semester to study the PSTs beliefs. We found that the idea proposed by Zazkis (2015) elicited a complex view of beliefs that are not captured by other methods.

## Literature Review

When defining beliefs, we are using a definition from Phillips (2007) that treats beliefs as "psychologically held understandings, premises, or propositions about the world that are thought to be true. Beliefs are more cognitive, are felt less intensely, and are harder to change than attitudes. Beliefs might be thought of as lenses that affect one's view of some aspect of the world

or as dispositions toward action. Beliefs, unlike knowledge, may be held with varying degrees of conviction and are not consensual. Beliefs are more cognitive than emotions and attitudes." (p. 259). Thompson proposed that a teachers' belief about mathematics influences how the decisions they make in the classroom while teaching and they could possess either a conceptual orientation or a calculation orientation towards mathematics (Thompson, Philipp, Thompson, & Boyd, 1994). Teachers who are conceptually oriented focus on engaging students in complex activities with a goal on developing problem-solving strategies or a deeper conceptual understanding while a calculation orientated view may emphasize calculations and procedures more.

Researchers have used several methods such as questionnaires where the participants respond to a series of questions and rate whether they agree with the statement on some scale. An example question could be "if students learn math concepts before they learn the procedures, they are more likely to understand the concept", which the participant can rate their agreement with the statement on a five-point scale from strongly disagree to strongly agree. Di Martino and Zan (2010) criticized this approach, as it uses questions that are entirely positive or negative. They argue that studying beliefs in this way is limiting by ignoring important factors such as the emotions of the individual and proposed a model that incorporated a students' vision of mathematics, emotional disposition, and their perceived competence to mathematics. Other researchers (e.g., Drake, 2006) explored PSTs' beliefs and identity by having them construct mathematical autobiographies. This approach produced a more multi-dimensional view of their beliefs as they described their changing relationship with mathematics by describing influential moments related to their experiences in mathematics.

Zazkis (2015) described a process to study PSTs' relationship with mathematics he called eliciting personification. The process entails having the PSTs' give life like attributes to a character called Math. The participants described this character and wrote a dialogue between themselves and Math. In this paper, we will use eliciting personification to (a) elicit PSTs' beliefs about mathematics, (b) incorporate their stories into the course, (c) have the PSTs construct new narratives about the mathematics they learned during the course, and (d) respond to their original narratives.

## Methodology

This study uses the eliciting personification method (Zazkis, 2015) to survey 68 sophomore PSTs enrolled in a semester long elementary mathematics content before they begin any of their teacher education classes. The course is taught out of a mathematics department with a focus on K-5 mathematics, counting, the operations, and rational numbers. Course material focuses on the standards for practice identified by NCTM. PSTs' engaged in open-ended problem solving, analyze the solutions of school-aged children through watching videos (e.g., Cognitive Guided Instruction, the Video Mosaic Collaborative), and look at written work. At the start of the semester, the PSTs responded to a slight modification of the assignment prompt posed by Zazkis (Figure 1).

At the end of the semester the students revisited the personification assignment in two ways (Figure 2). The first part has the PSTs' write a new personification, but about this character called "New Math" based on the mathematics we explored throughout the course. Then the PSTs revisited the assignments they submitted at the start of the semester through the lens of a future mathematics teacher and imagine that a student submitted that assignment to them. They wrote a

# script for a dialogue they would want to have to this student and what they would like to tell them.

The following assignment is designed to help you explore your own relationship and personal history of mathematics through personification. Be sure to put a good amount of thought into your mathematics character. Being honest and thoughtful with this assignment will be more useful for you with regards to this class and your future as an elementary school teacher.

#### Who is Math?

Write about who Math is (approximately 300 words). This section should address things such as: How long have you known each other? What does Math look like? What does Math act like? How has your relationship with Math changed over time? These questions are intended to help you get started. They should not constrain what you choose to write about.

#### Dialogue with Math

Now that you have created a Math-character, write a script for a dialogue that you might have with Math (300-500 words). Here are some examples of questions you might want to think about. As before, these questions are intended to help you get started and should not constrain what you choose to put in the dialogue: Are there things you want to tell Math that you have not said before? Are there things that you think Math wants to tell you? How did you and Math get along in a recent mathematics course that you took? Was the relationship during recent courses different from the relationship you had years ago? What do you suppose that Math turned out the way they did? Do you think Math can ever change? Do you want Math to change? What kind of relationship would you like to have with Math?

## Figure 1: Beginning of the semester personification prompt from Zazkis (2015).

- 7. (20 points) At the beginning of the semester you worked on an assignment that had you give life to a character called Math. For this question I would like you to re-visit the assignment. Your write-up should be approximately 300-500 words. Be sure to put a good amount of thought into your assignment. Being honest and thoughtful with this question will be useful for you with regards to your future as a teacher. Your write-up should address the following:
  - (a) In this class I tried to introduce a different way to think about Mathematics. I would like you to write about this "different" Math. What does this Math look like? What does this Math act like? How, if at all, is this Math different than the one you knew before this course?
  - (b) Re-read the assignment you submitted at the beginning of the semester (if you are doing this during the exam and not at home - I have your assignment, get it from me). Look at your assignment through the lens of a mathematics teacher. If a student turned in this assignment to you, what would you say to him or her? Write a script for a dialogue that you might have with this student (aka an August 2017 version of you). Are there things you want to tell that student?

Figure 2: End of the semester assignment prompt.

To examine how elementary PSTs' conceptualize mathematics we utilized a narrative identity lens (Kaasila, 2007). Narratives create opportunities to view how the narrator constructs the world around them (Lutovac & Kaasila, 2011). According to Sfard and Prusak (2005), teacher identities are just collections of narratives that can inform future actions. Narratives provide a conduit in exploring ones' own identity and the identities of the personalities created within the narratives. Researchers have also shown self- exploration of created narratives to have positive impacts on mathematics related anxiety (Kaasila, Hannula, & Laine, 2012; Lutovac & Kaasila, 2011; 2014).

The authors analyzed the submitted write-ups by the PSTs' using a thematic analysis (Braun & Clarke, 2006) approach to open-code and develop themes related to beliefs about mathematics through the narrative identity lens. Throughout the process, the authors discussed their codes and themes and talked about any differences they had. In this paper we are presenting common themes across the assignments from the start of the semester and how, if at all, those themes shifted by the end of the course.

## Results

Forty-eight of the participants wrote about the first time they met their Math character and of those, 45 described first meeting Math during school, with 42 saying they first met Math in Kindergarten and three students in second grade. Two of the other students mentioned meeting Math as soon as they began counting and one student remarked that "informally, they knew Math all their life, but I was formally introduced to Math when I attended school". A majority of the assignments also mentioned engaging with or avoiding Math in a school setting while others implied Math had not existed outside the school setting/environment.

A second common theme that arose when describing Math was that it had multiple personalities with contrasting personalities. One student described their math character as "kind, but also stern" and another saying "one day Mathius wants to be friendly and cooperate with me and the next minute he wants to cause trouble and make my life difficulty...I have seen these rapid personality changes in Mathius ever since I have known him". Common amongst the described multiple personalities was that one side was friendly towards that and wanted to help while the other personalities were mean and out to intentionally hurt them. A positive attribute assigned to Math was that he was logical, but also that there was only one way to understand his solutions which seemed to give some students comfort as demonstrated in the statement, "....although it may not seem like it, there is always a solution to every problem, I just have to figure it out". Other themes the PSTs' wrote about were growing apart from their character Math and wanting to rebuild their friendship. Algebra, geometry and calculus were described as points where their relationship with Math deteriorated due to the increased complexity in content as many of them claim in their reflections.

In their dialogues, some PSTs' addressed their failing relationship with Math. One student had math telling them that "Your lack of effort is why you didn't do as good as me in Algebra" to which they responded "That's very true. I should have managed myself better to do great in the class". Several students expressed communication issues with Math, such as "In fourth grade Math completely changed on me. No longer did we communicate the same. My teacher decided that Math would no longer speak to me the same way. I was forced to speak to Math in English. Our whole friendship was based on how we had no language barrier in Spanish. We lost the friendship I relied on to help me reach the goals I had placed for myself".

In their second assignment, the "new Math" character described by the students was different than the Math they knew growing up. The student who struggled with being forced to speak to Math in English described this new character as "This Math wasn't trying to confuse me, but help guide me to help others. This Math wasn't out of my grasp this time. Math was almost speaking the same language again...Math was a lot friendlier than I remember and once I gave him a fair shot it wasn't hard to get along". A majority of the participants who described Math as having multiple confusing and conflicting personalities, described the new character as "straight forward", "more approachable", "the old math scared me causing not to speak up and ask a question...This math is different, more patient, understanding and has taught me to look at this subject in a different light". Others described this new Math as having "soft, king eyes that glow with radiance and happiness", "more approachable", "thes a lot of very different layers that somehow all come together in a cohesive way", "definitely kinder than the 'mean' one that I portrayed earlier", "lives with me everyday" and it "welcomes me with open arms and wants to help".

When assuming the role of the teacher and responding to their beginning of the semester-self, the students responses included "Always keep trying, never give up on a problem just because you don't understand it. Ask questions, because you might not be the only student who does not understand what they just learned. I learned that there are multiple ways to solve a problem. You don't have to solve them a certain way.", several students suggested that they "don't be afraid to ask for help", to "not be discouraged and that a lot of people experience the same problems", and to focus on "try and understand the reasoning behind how math works rather than trying to just get the right answer".

### Discussion

At the start of the semester the PSTs in the study exhibiting several negative beliefs related to mathematics. PSTs' that engaged in the task viewed mathematics as an activity that occurred only in schools. They first met math when they entered school and all their described interactions, both positive and negative, occurred in a school setting or by engaging in tasks related to schooling (e.g., homework). They described a volatile relationship where math was alternating between a positive relationship and one which was out to hurt or punish them. They identified mathematics having a logical structure as a positive attribute, but as a result they viewed math as having only one way to approach a problem which was a negative attribute. When they tried to understand why their relationship failed they blamed themselves by saying they did not try hard enough and claimed all they needed to do was try harder indicating that their lack of persistence was the reason for their diminished relationship with Math.

After a class focused on teaching mathematics through a more conceptually based approach, the PSTs' vision about how the mathematics we talked about in class was a stark contrast to their view of mathematics growing up. Their focus was on a more approachable mathematics that wants to help the students understand. Instead of blaming themselves for not working hard enough, they instead realized that they could ask questions of others to help understand the content and that math was "kind" and wanted the best for them. They also shifted towards more of a conceptual orientation view of mathematics as they focused on understanding and multiple ways to approach a problem instead of rote procedures with an emphasis on finding a solution. They also mentioned the overall utility of the mathematics they were learning and how they would use this "new Math" in their classrooms.

Being able to read their stories gave the authors a unique opportunity to engage with their PSTs' and provide a way to frame issues that came up throughout the class. The personifications produced painted a complex view of their relationship that is not captured by belief assessments. It also created an opportunity for PSTs' to re-frame their experiences and produce more productive ways of addressing the issues they identified along with implications for future teaching. Going forward, research is needed to focus on how to leverage activities such as this to help build positive identities and dispositions towards mathematics for future teachers.

## References

- Association of Mathematics Teacher Educators. (2017). *Standards for Preparing Teachers of Mathematics*. Available online at amte.net/standards.
- Di Martino, P., & Zan, R. (2010). 'Me and maths': towards a definition of attitude grounded on students' narratives. *Journal of Mathematics Teacher Education*, *13*(1), 27-48.

- Drake, C. (2006). Turning Points: Using Teachers' Mathematics Life Stories to Understand the Implementation of Mathematics Education Reform. *Journal of Mathematics Teacher Education*, *9*(6), 579-608. doi:10.1007/s10857-006-9021-9
- Kaasila, R., (2007). Using narrative inquiry for investigating the becoming of a mathematics teacher. *ZDM*, *39*(*3*), 205-213. doi:10.1007/s11858-007-0023-6
- Kaasile, R., Hannula, M. S., & Laine, A. (2012). "My personal relationship towards' mathematics has necessarily not changed but..." Analyzing pre-service teachers' mathematical identity talk. *International Journal of Science and Mathematics Education*, 10(3), 975.995. doi:10.1007/s10763-011-9308-x
- Lutovac, S., & Kaasila, R. (2011). Beginning a pre-service teacher's mathematical identity work through narrative rehabilitation and bibliotherapy. *Teaching in Higher Education, 16*(2), 225-236. doi:10.1080/13562517.2010.515025
- Lutovac, S., & Kaasila, R. (2014). Pre-service teachers' future-oriented mathematical identity work. *Educational Studies in Mathematics*, *85*(1), 129-142. doi:10.1007/s10649-013-9500-8
- Phillips, R. A. (2007). Mathematics teachers' beliefs and affect. In Lester, F. K. (Ed.) Second Handbook of Research on Mathematics Teaching and Learning. Pp. 257-315. Charlotte, NC: Information Age Publishing.
- Phillippou, G. N., & Christou, C. (1998). The effects of a preparatory mathematics program in changing prospective teachers' attitudes towards mathematics. *Educational Studies in Mathematics*, 35, 189-206.
- Sfard, A., & Prusak, A. (2005). Telling identities: The missing link between culture and learning mathematics. In H. L. Chick & J. L. Vincent (Eds.), *Proceedings of the 29th Conference of International Group for the Psychology of Mathematics Education* (Vol. 1, pp. 37-52). Melbourne, Australia: University of Melbourne.
- Thompson, A. G., Philipp, R. A., Thompson, P. W., & Boyd, B. A. (1994). Calculation and conceptual orientations in teaching mathematics. In D. B. Aichele & A. F. Coxford (Eds.), *Professional development for teachers of mathematics* (pp. 79-92). Reston, VA: National Council of Teachers of Mathematics.
- Zazkis, D. (2015). Monsters, lovers and former friends: Exploring relationships with mathematics via personification. *For the Learning of Mathematics*, *35*(1), 33-38.